UC1b: Agro-environmental monitoring

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NIVA Stakeholder Forum Santorini
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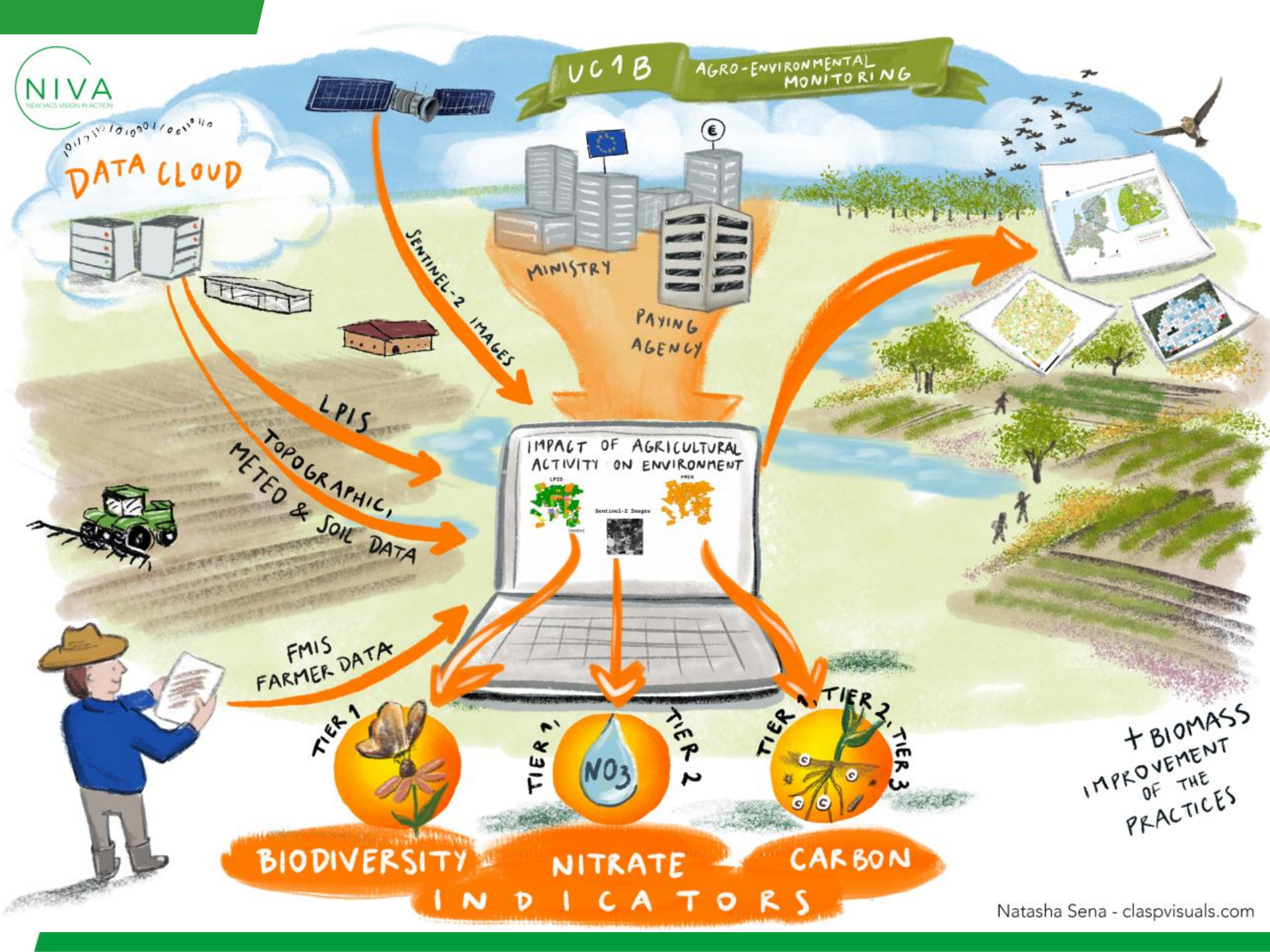

NIVA
NEW IACS VISION IN ACTION
UC1B AGRO-ENVIRONMENTAL MONITORING
DATA CLOUD
SENTINEL-2 IMAGES
MINISTRY
PAYING AGENCY
LPIS
TOPOGRAPHIC, METEO & SOIL DATA
IMPACT OF AGRICULTURAL ACTIVITY ON ENVIRONMENT
LPIS
Sentinel-2 Images
FMIS
FMIS FARMER DATA
TIER 1
TIER 1
TIER 2
TIER 1
TIER 2
TIER 3
NO3
+ BIOMASS IMPROVEMENT OF THE PRACTICES
BIODIVERSITY
NITRATE
CARBON
INDICATORS
Natasha Sena - claspvisuals.com

UC objective

Objective

- What is the UC about?

Agricultural activities have a strong impact on the environment. UC1b has developed a set of indicators based on existing scientific methods and on data widely available in Europe (IACS, Sentinel-2 images, topographic data)

- What was the objective?

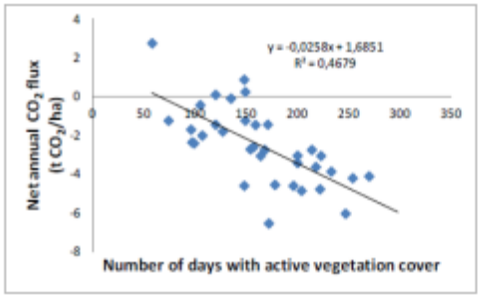
These indicators may contribute to assess some of the new CAP objectives and some Sustainable Development Goals

UC results

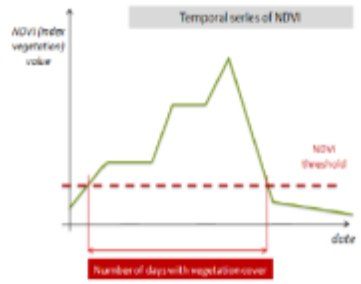
CT1 annual CO_2 flux due to crop vegetation cycle

- CO_2 flux takes into the account the CO_2 emitted in the atmosphere (plants and soil respiration) and the CO_2 stored by plants due to photosynthesis.
- The computation of CO_2 flux is based on an empirical method: for main crops, annual CO_2 flux depends on the number of days with active vegetation. This number of days is estimated from NDVI temporal series (from Sentinel-2 images).

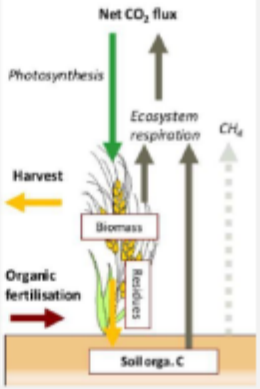
List of crops concerned by the empirical method



Relationship between CO_2 flux and the nb of days with active vegetation



The NDVI threshold corresponding to bare soil enables to derive the nb of days with active vegetation



- The computation tool has been tested on various areas in Europe (France, Denmark, The Netherlands, Spain)

CT1 annual CO_2 flux due to crop vegetation cycle

Operational for entire countries at parcel level

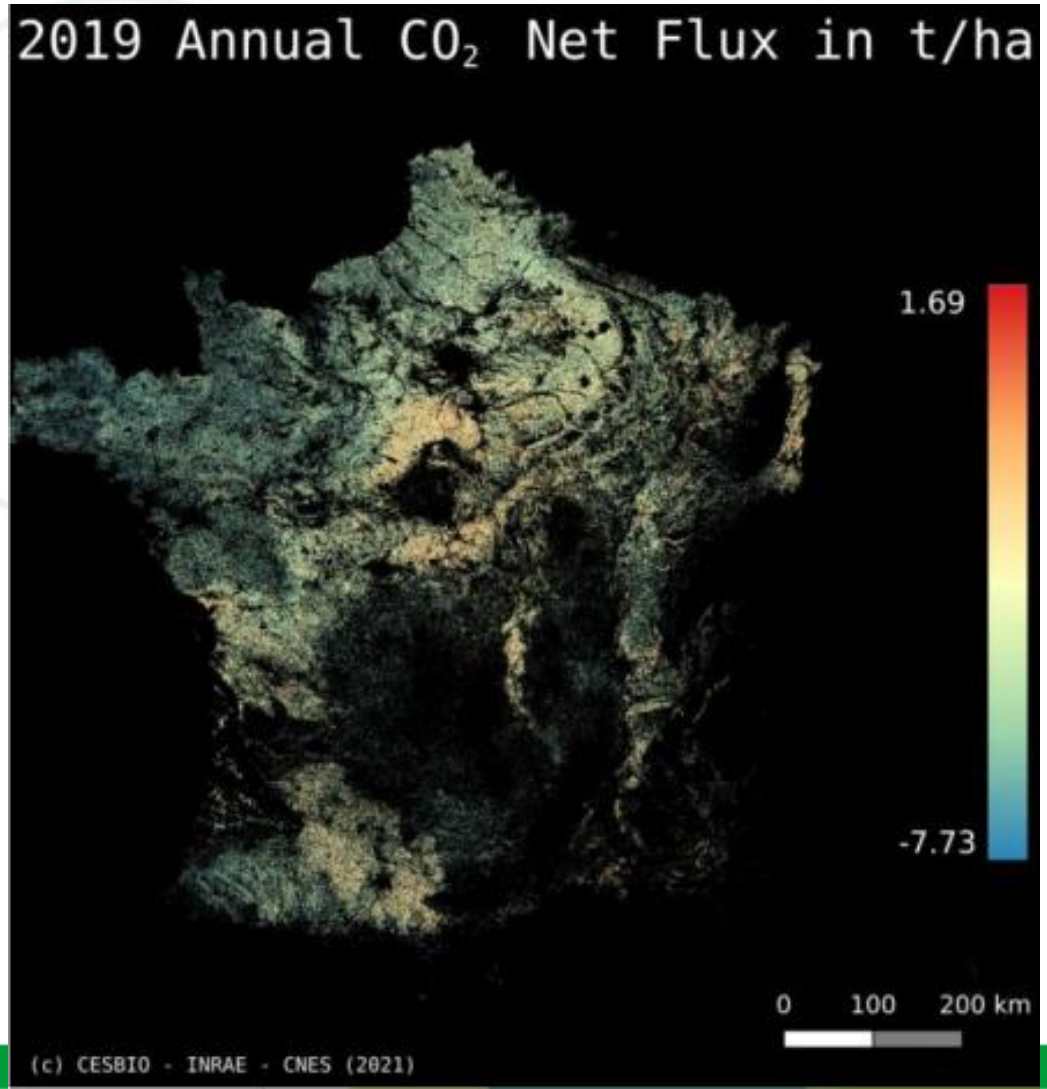
NL CT1 parcel

Net annual CO_2 fixation

Net annual CO_2 losses

CT1 annual CO_2 flux due to crop vegetation cycle

And at pixel level

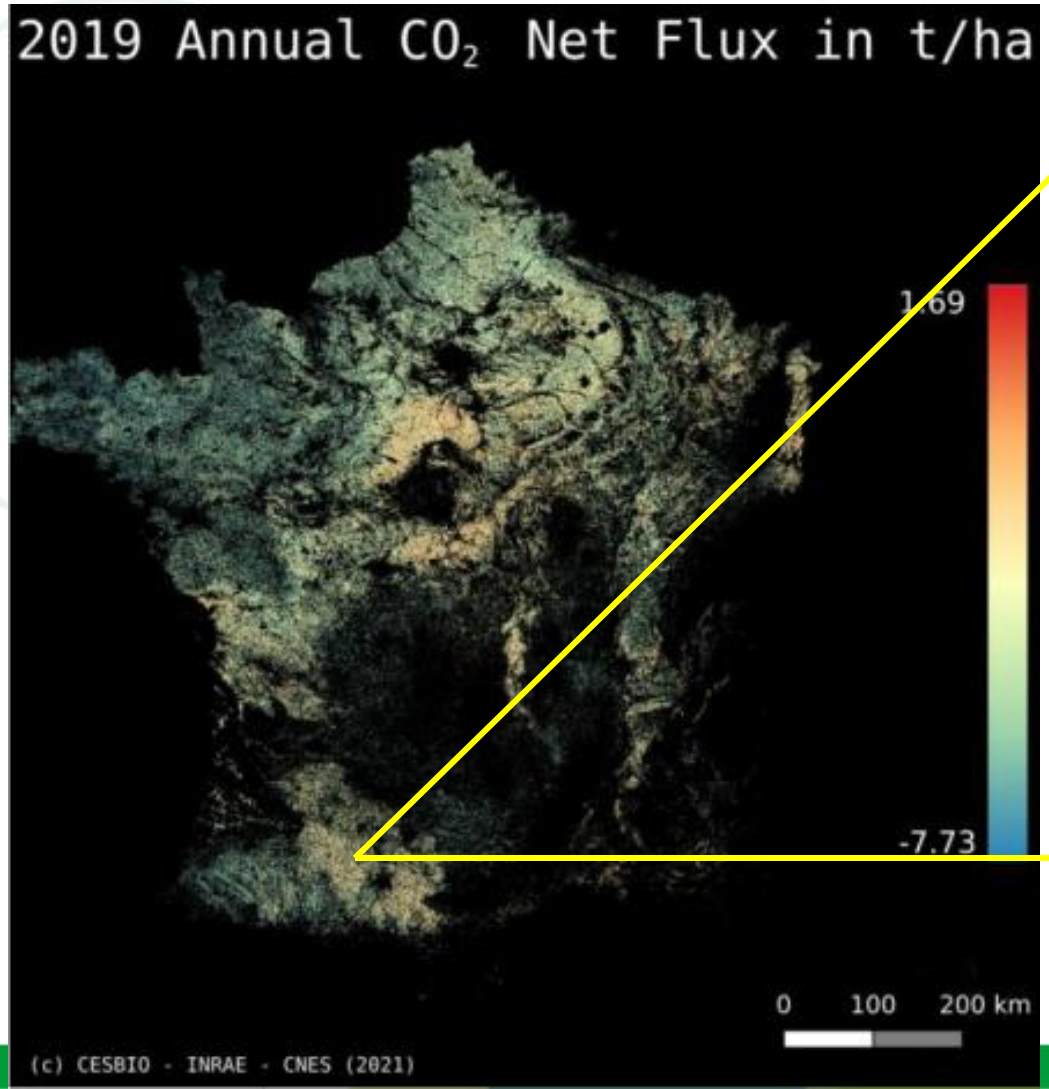


Net annual CO_2 fixation

Net annual CO_2 losses

CT1 annual CO_2 flux due to crop vegetation cycle

And at pixel level



Variability inside parcel

2018

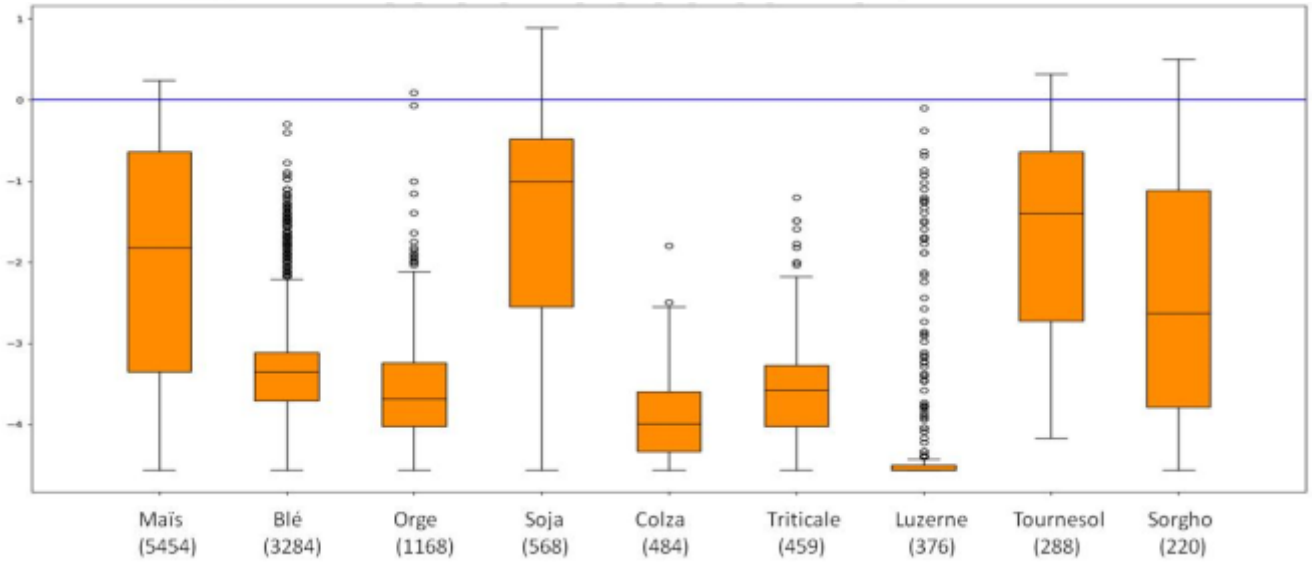
2019

Net annual CO_2 fixation

Net annual CO_2 losses

CT1 annual CO_2 flux due to crop vegetation cycle

Allows statistical analysis per crop type



Variation of CO_2 fluxes by type of crop in Ain French department in 2019

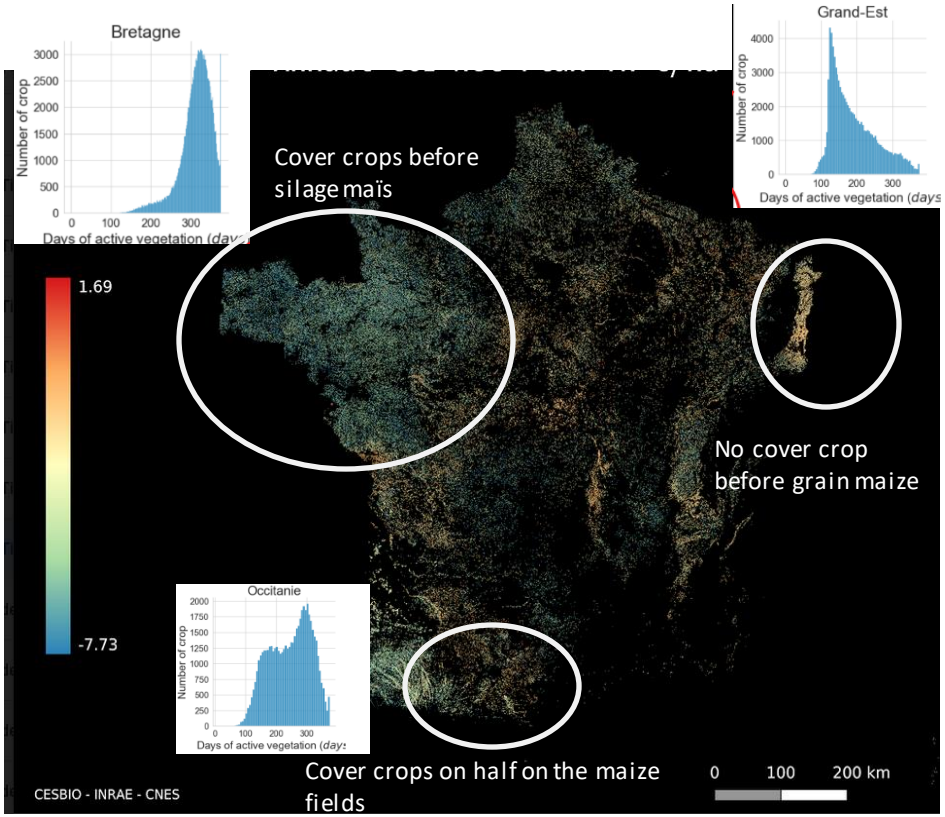
Summary table						
PAC 2020			GRANULE 30 TUM - R137			
UC1b (NIVA)	Num.Parcels	5%	Num.Parcels	Surface (ha)	Average C02_Flux (tm/ha)	CO2_Total™
rapeseed	7.130	357	1.081	5.881	-3,610	-21.230
peas	8.617	431	4.059	15.569	-1,700	-26.467
winter/summer wheat	301.890	15.095	49.270	163.584	-2,880	-471.122
winter/summer barley	308.145	15.407	68.176	228.995	-2,400	-549.588
winter/summer rye	39.224	1.961	1.699	5.662	-2,680	-15.174
winter/summer oats	41.649	2.082	6.401	20.629	-2,820	-58.174
triticale	312	16	48	244	-2,670	-651
sunflower	81.225	4.061	13.355	57.264	-0,270	-15.461
maize	44.463	2.223	2.922	11.263	-2,410	-27.144
potatoes	7.234	362	741	2.054	-1,930	-3.964
sugar beet	4.292	215	1.337	5.351	-3,140	-16.802
	844.181	**42.209**	**149.089**	**516.496**		
			17,66	%		

A summary table of CO2 fluxes by type of crop in Castil and Leon, Spain in Oct 2019- Sept 2020

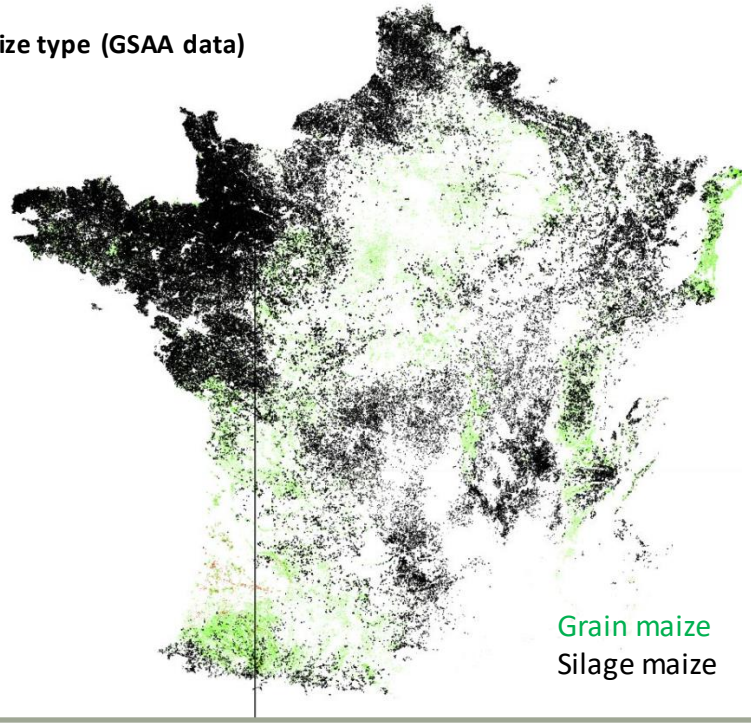
CT1 annual CO_2 flux due to crop vegetation cycle

Effect of management (harvest date, cover crops) and regulation (nitrate directive)

Net CO_2 fluxes for maize fields in France in 2019



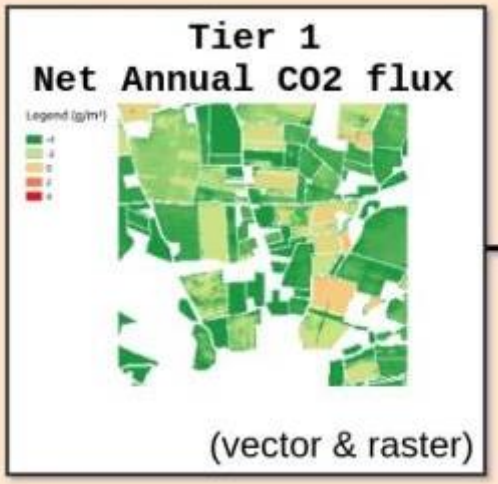
Maize type (GSAA data)



Silage maize stores more CO_2 than grain maize, despite of shorter vegetation cycle. This is due to the legal obligation of permanent soil cover (nitrate mitigation).

Even such a simple approach allows to catch the effect of regulation/management on the indicator ➔ gives confidence in the results

CT2- Annual Carbon budget

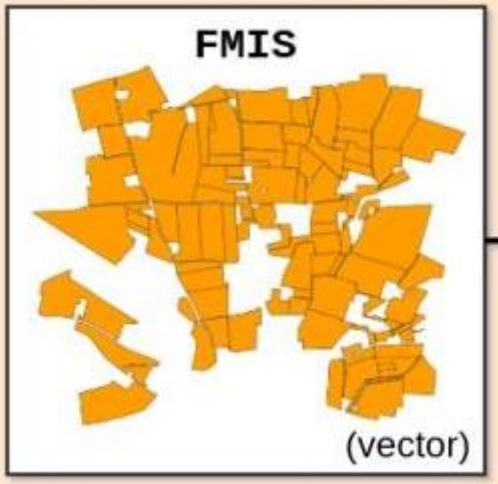


Empirical approach ➔ main crop species except rice

Currently tested in France in collaboration with

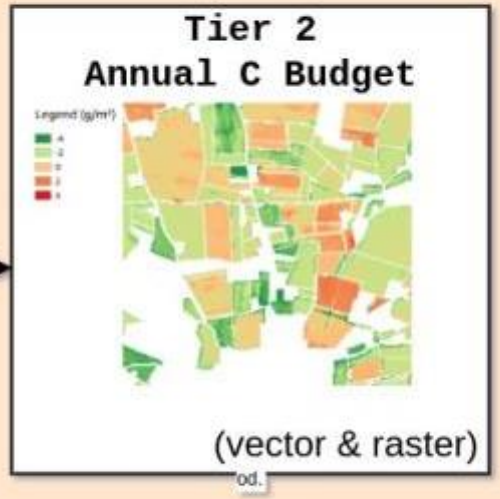
AGRO D'OC
UNION DES CETA D'OC

AGRICULTURES & TERRITOIRES
CHAMBRES D'AGRICULTURE



Tier 2 Calculator

T2 Annual Carbon Budget
=
T1 Net Annual CO_2 flux
+
Carbon harvested
–
Organic amendments



➔*Main limit: access to farmers data (manual collection, individual consent)*

➔ *Allows soil C stock changes to be quantified*

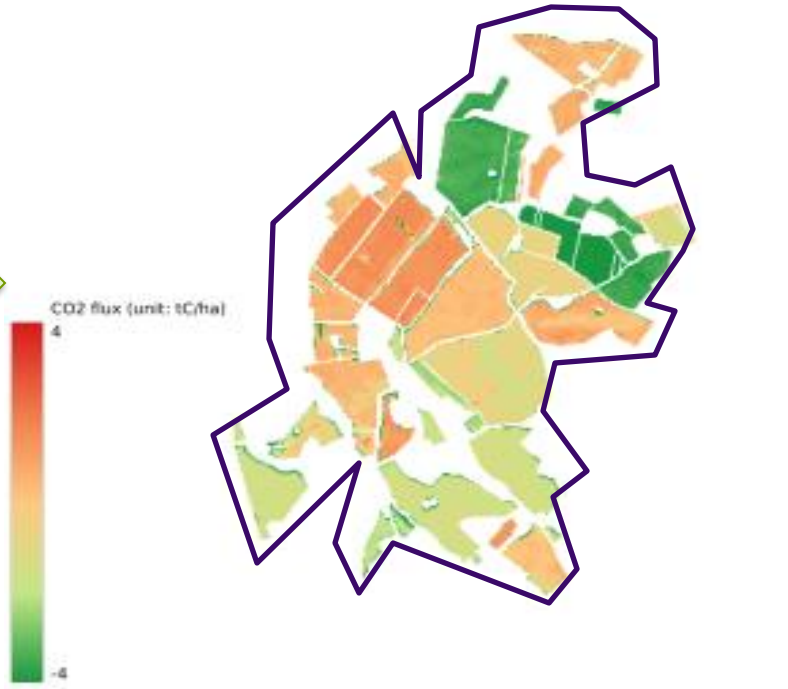
The C budget depends on the annual net CO_2 flux (TIER 1), on organic amendments and on the export of biomass (C) at harvest

CT2- Annual Carbon budget

Carbon Indicator Tier1

+ FMIS

Carbon Indicator Tier2



Tested in South West France in collaboration with

Avec et pour les céréaliers
AGRO D'OC
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CT3- Annual Carbon budget

Meteo data (csv)

Crop model ➔ straw cereals, maize, sunflower, cover crops

CESBIO Pique et al. (2020 a & b)

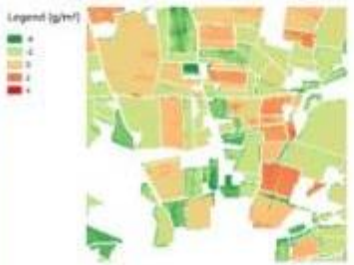
GSAA (vector)

Sentinel-2 Images (raster)

Tier 3 - Calculator

SAFY-CO2
Agro-meteo Model

Tier 3 Annual C Budget



(vector & raster)

FMIS

Farmer data (vector)

+ yield, biomass, CO_2 fluxes

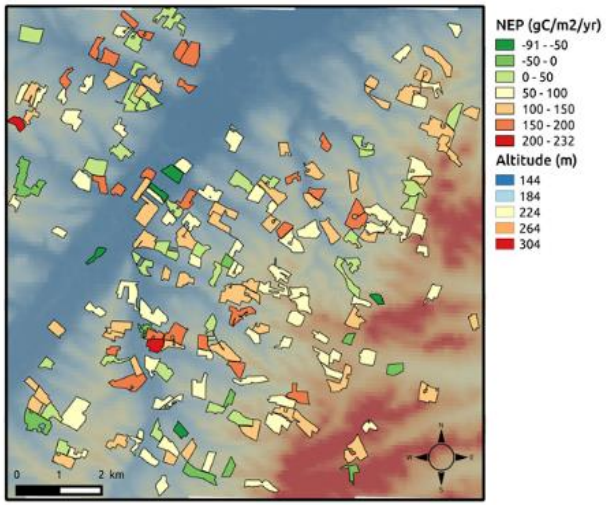
Large validation dataset: ICOS flux towers, Regional Space Observatory

CO_2 fluxes are calculated by the model where vegetation component is calibrated by the LAI derived from Sentinel-2. Farmer's data are needed to calculate the C budget

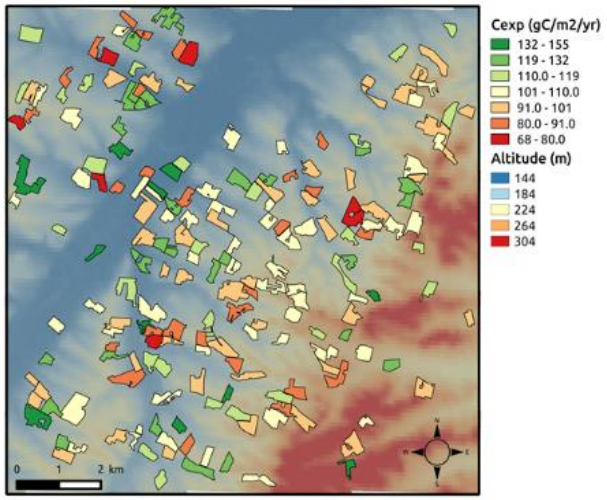
CT3- Annual Carbon budget

- Sunflower plots 30 km west of Toulouse

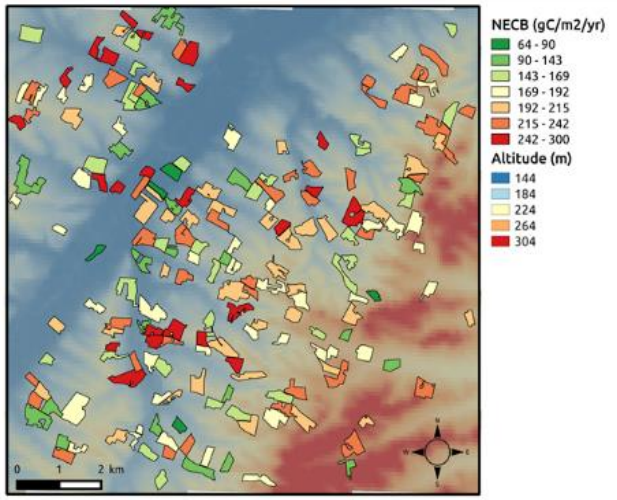
Pique et al (2020b) in Remote Sensing



Net CO_2 flux



C harvested



C budget

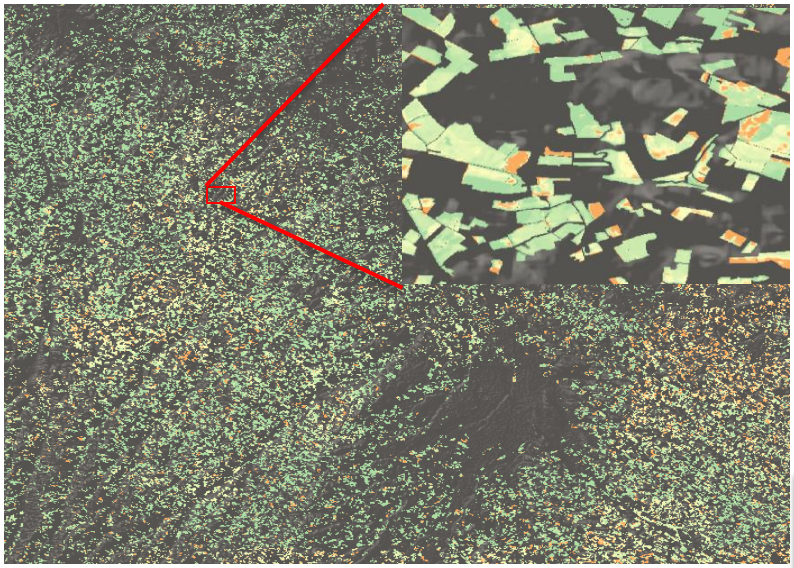
- High spatial variability of the components of the carbon budget
- Plots with cover crops or wheat volunteers fix atmospheric CO_2, but as some C is exported at harvest, finally even those plots loose C in the soil

Multi-Member testing phase with Spain ongoing

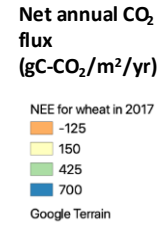
CT3- Annual Carbon budget at pixel scale

SAFYE-CO2 is embeded in the AgriCarbon-EO processing chain

Net annual CO_2 fluxes for 2018 straw cereals in South West France (10 m resolution)

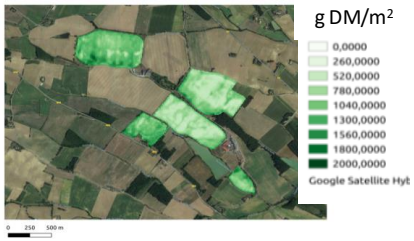


Whole Sentinel 2 Tile (31TCJ)



+ Farmer's data

Cover crop biomass



Uncertainty map

10m resolution C budget map for cover crop/maize/wheat crop rotations

Villeneuve farm, Bézéril, France

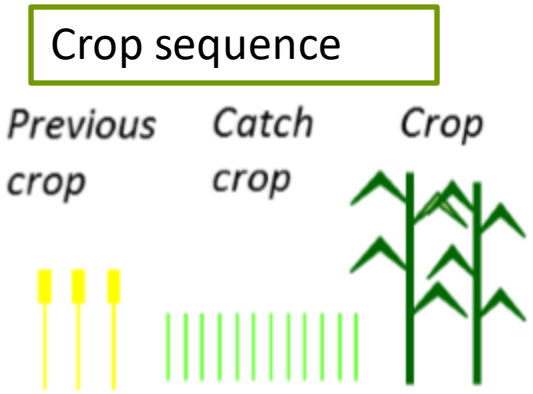
CO_2 fixation / soil C storage

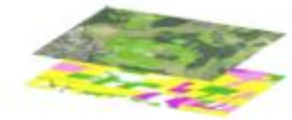
CO_2 losses / soil C loss

Tested in South West France: still under development

NT1 - Nitrate leaching indicator

- The indicator measures the risk of nitrate leaching due to crop sequence over a drainage period.
- Nitrate leaching triggers a risk for water quality and a loss of soil nutrients.
- UC1b nitrate leaching indicator is based on the following principles:
  - After harvest, soil and crop stubbles release nitrate due to mineralization
  - The new crop takes up nitrate for its growth
  - A catch crop or other intermediary cover takes up nitrate for its growth

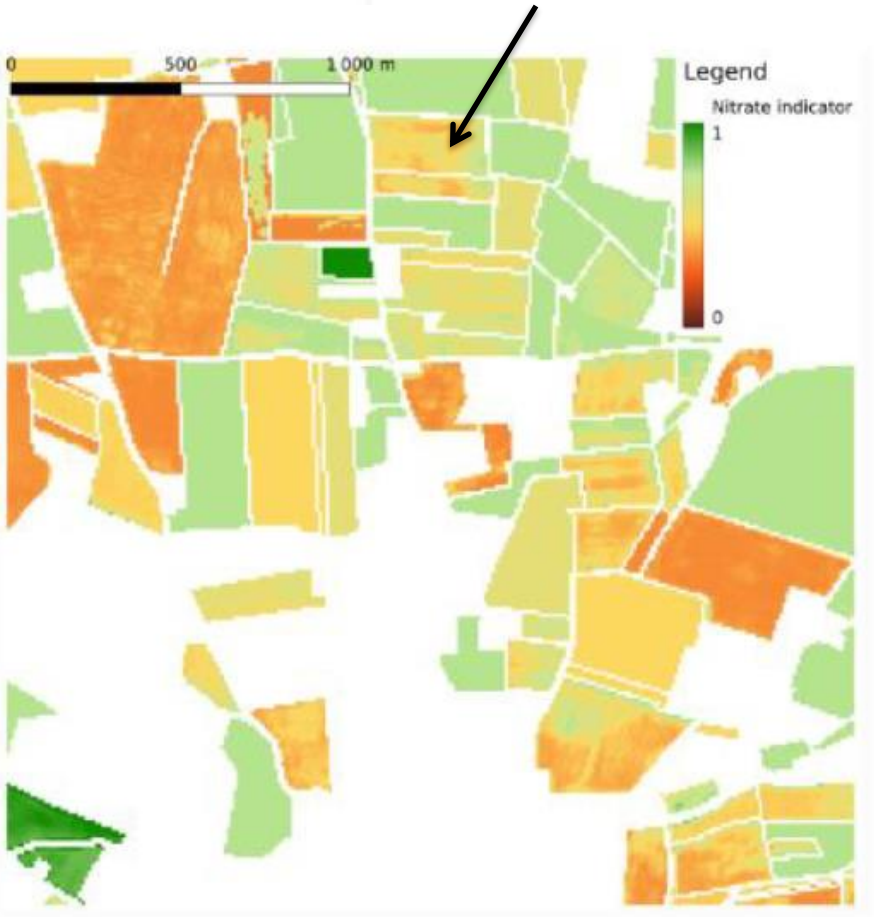




IACS data provide information about previous and current crops.

Information about catch crop is derived from Sentinel-2 images (NDVI temporal series)

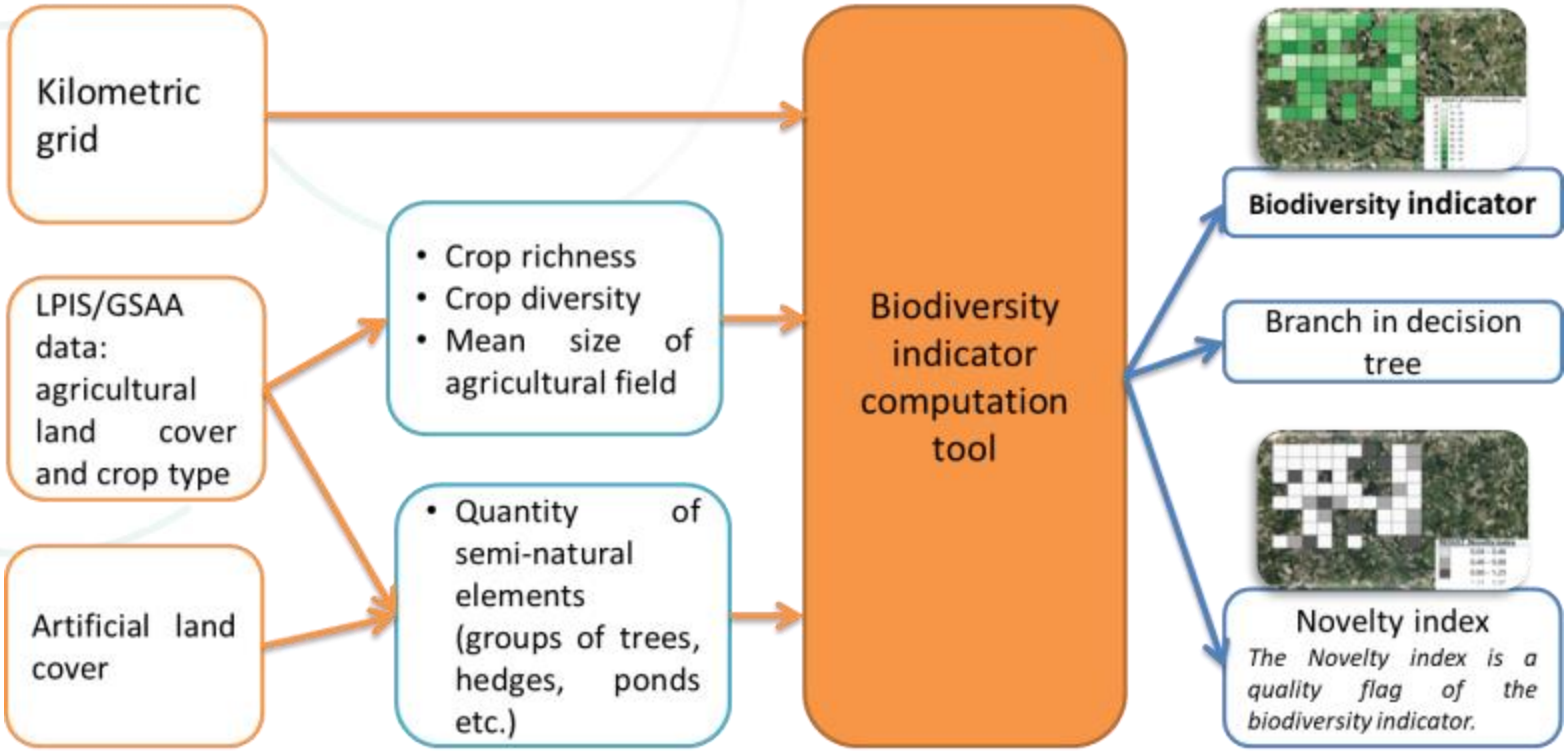
NT1 - Nitrate leaching indicator



The nitrate leaching indicator is computed at pixel level and expressed on a scale between 0 (low) and 1 (high).

BT1 - Biodiversity indicator

- Land cover characteristics and agricultural practices influence the potential of an agricultural landscape to host a high proportion of species that occur in that region.

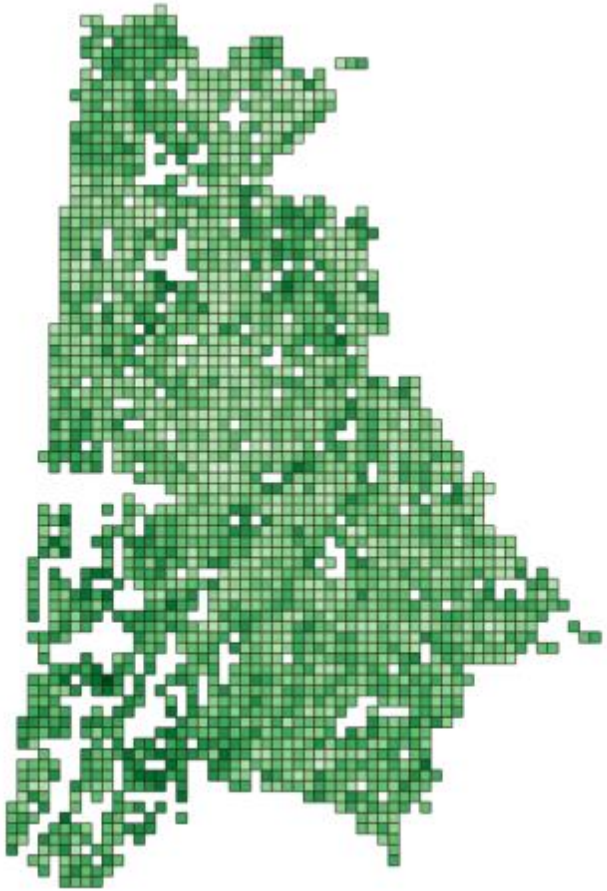


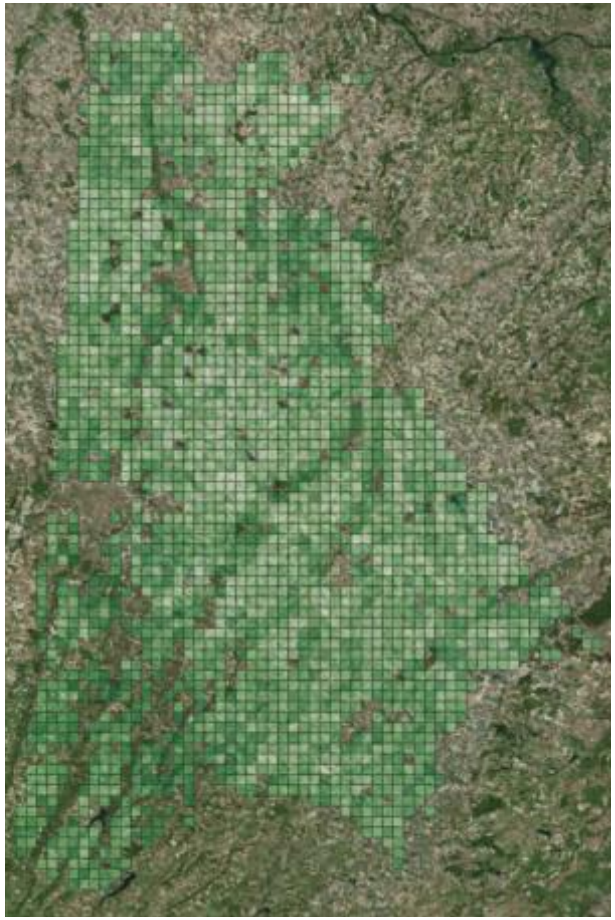
- The biodiversity indicator corresponds to a multi-diversity index that takes into account the species richness of 7 taxonomic groups.

BT1 - Biodiversity indicator

Results from testing in France

- E Gers department
- 2631 kilometric cells





Results

- UC1b delivered the following simulation tools :
  - CT1 at parcel level: https://gitlab.com/nivaeu/uc1b_tier1_co2
  - CT1, CT2, NT1, CT3 SAFYE-CO2 at pixel level: https://gitlab.com/nivaeu/uc1b_indicators_tool
  - BT1 at 1km^2 grid level: https://gitlab.com/nivaeu/uc1b_tier1_biodiversity

- Anonymus results and more details are available openly at Zenodo platform: https://zenodo.org/communities/niva4cap/?page=1&size=20

UC benefits

Benefits

Provides homogeneous and objective estimate of some of the environmental impacts of agriculture.

- The components can be used for:
  - Presenting beneficial environmental impact of good practices (intermediary covers, relevant crop rotation, strip cropping)
  - Voluntary carbon farming (CT3),
  - Science and more generally environmental monitoring
- How does the UC contribute to the CAP and IACS?
  - No legal obligation so far
- When will the benefits be available for the user?
  - When the results are calculated, interpreted and shared at a large scale
- Who or what benefits most from this UC?
  - Farmers (better overview of their land)
  - Agricultural and environmental public administration and general public because it will help to monitor agricultural impact and therefore it may improve the environment.

UC challenges

Challenges

Challenge	Ideas	Needs
No formal obligation to implement agro-environmental monitoring → no strong driver to compute the indicators	Indicators might be integrated in far-future CAP	Political decisions
Storage and processing of the input and output data	• DIAS • subcontracting with private companies • Copernicus Global Land Service - High Resolution Vegetation Phenology and Productivity	Responsible public body
Competences/ resources of the PA/ public administration to compute the tools and interpret the results	Training sessions	Responsible public body

Challenges

Challenge	Ideas	Needs

Access to farmer's data for TIER2 & 3 (management of the consent, reliability, standardization)	• Discussions with the farmer's organizations (consent)
	• APIs and exchange with farmer's organizations
		• Legal decision on FMIS data collection and sharing
		• Global initiatives to get farmer's consent
		  • Private initiatives to standardize data exchange & manage consent (like AGdatahub (FR), DjustConnect (BE), JoinData (NL))
		  • Role of the EC to coordinate standardization actions?

Communication of the results to farmers while keeping the privacy of the results	Farmer's dashboard integrated in the FMIS or dedicated web services	

Challenges

Needs
Political decisions
Responsible public body

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  • role of the EC to coordinate standardization actions?

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THANK YOU!

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